Chapter 6 :

Conduct of Pilot Study

Chapter 6. Conduct of Pilot Study

6.1. Description of Pilot Study Area

6.1.1. Selection of Pilot Study Area (PSA)

The seismic damage analysis carried out for the entire Tehran area indicates that the southern part of the city of Tehran will be severely damaged in the event of an earthquake caused by fault activity on the South Ray Fault. One reason for the expected, huge seismic damage is that the southern part of Tehran is not only located close to an earthquake source, but also has many buildings that are constructed with traditional materials such as brick, masonry, wood and steel. Building structures of this area also seems to be non-resistant to strong earthquakes. Besides these conditions, the population density of the area is the highest in Tehran, and even one of the highest in the world. According to the 1996 Census Data, a number of its census zones have a population density of over 500 persons per hectare and, sometimes, exceed 700 persons per hectare. Due to the combination of these physical and social conditions and the growth of population, the potential vulnerability against a strong earthquake seems to be growing every year. District 17 has been designated as the Pilot Study Area (PSA) in order to identify and collect basic information for the preparation of necessary measures to mitigate a seismic disaster. Detailed building and urban land use surveys were conducted. Based on these surveys and analyses, existing problems for seismic disaster prevention/preparedness in the PSA were identified and are discussed below.

6.1.2. Outline of the PSA

The PSA is located in the central part of District 17 (Figure 6.1.1). As of 1996, the district consists of 13 census zones: census zones number 84, 85, 86, 87, 88, 89, 90, 91, 92, 95, 96, 98 and 99. These zones are subdivided into 150 blocks in total. The combined population of these zones is 32,239, with a population density of 465 persons per hectare. The total number of buildings in these zones is 4,843. Statistical data for the existing social conditions of the PSA is listed in Table 6.1.1.

The geographical location of the PSA is the southern part of Tehran where the lowest edge of a large alluvial fan is formed from north to south by several rivers flowing down from the Alborz Mountains. The topographical elevation of the area ranges from 1120 m to 1110 m above sea level and the ground surface is gently sloped from north to south. The ground condition is mainly composed of stiff clay including fine sand.

Urbanisation of this area has been progressing since the 1960' s, owing to the concentration of population in Tehran. Before the urbanisation took place, the area had been extensively used as agricultural land. Building development in this area is mainly targeted for residential use; therefore, almost all of the buildings in this area were constructed with less than three stories. There are a limited number of buildings in the area with more than five stories that are mainly used for residential purposes, but the sides of these buildings facing the street are used for business or commercial purposes, e.g., small shops and small-scale industries. A combination of steel, brick and wood is used as building materials, although this combination is very weak against a strong earthquake.

Table 6.1.1 Social Conditions Of The Pilot Study Area (1)

Zone Number	Block Number	No of Buildings	Parcels Area (ha)	Population	Density (person / ha)	Building Structure			Building Usage					
						Steel	Steel and Brick	Others	Residential	School	Workshop	Medical	Public Usage	Others
17084	1	28	0.245	224	914	3	24	1	27	0	0	0	1	1
	2	29	0.285	215	753	0	29	0	29	0	0	0	0	0
	3	31	0.350	239	682	2	29	0	29	0	0	2	0	2
	4	33	0.380	270	711	1	31	1	32	0	0	0	1	1
	5	36	0.348	275	789	5	31	0	36	0	0	0	0	0
	6	147	1.473	1,331	904	26	120	1	146	0	0	1	0	1
	7	37	0.343	326	949	11	25	1	37	0	0	0	0	0
17085	1	31	0.314	336	1,072	6	25	0	30	0	0	1	0	1
	2	17	0.163	176	1,080	2	15	0	17	0	0	0	0	0
	3	1	0.017	12	698	0	1	0	1	0	0	0	0	0
	4	16	0.128	142	1,111	1	15	0	16	0	0	0	0	0
	5	6	0.048	49	1,028	3	3	0	6	0	0	0	0	0
	6	315	2.990	2,975	995	13	294	8	311	0	0	0	0	0
	7	5	0.046	33	711	5	0	0	5	0	0	0	0	0
17086	0	1	0.006		-	0	0	1	0	0	0	0	0	0
	1	21	0.199	171	858	13	7	1	18	0	0	1	1	2
	2	21	0.164	179	1,090	16	4	1	21	0	0	0	0	0
	3	21	0.157	165	1,049	11	10	0	21	0	0	0	0	0
	4	20	0.156	155	994	15	5	0	20	0	0	0	0	0
	5	16	0.214	138	646	8	8	0	15	0	0	0	1	1
	6	23	0.174	197	1,129	2	21	0	19	0	4	0	0	4
	7	22	0.192	188	979	0	22	0	21	0	1	0	0	1
	8	18	0.151	158	1,045	0	17	1	17	0	0	0	0	0
	9	18	0.146	140	956	0	17	1	17	0	0	0	0	0
	10	19	0.147	109	741	0	18	1	16	0	1	1	0	2
	11	12	0.138	99	718	2	10	0	12	0	0	0	0	0
	12	14	0.300	105	351	0	13	1	13	0	0	0	0	0
	13	34	0.840	322	384	16	18	0	33	0	0	0	0	0
	14	15	0.358	161	450	8	7	0	14	0	0	0	0	0
	15	12	0.302	152	503	6	6	0	12	0	0	0	0	0
	16	14	0.337	119	353	7	7	0	13	0	0	0	0	0

Table 6.1.1 Social Conditions Of The Pilot Study Area (2)

Zone Number	Block Number	No of Buildings	Parcels Area (ha)	Population	Density (person / ha)	Building Structure			Building Usage					
						Steel	Steel and Brick	Others	Residential	School	Workshop	Medical	Public Usage	Others
17086	17	4	0.149	27	181	3	1	0	2	0	1	0	0	1
	18	16	0.200	129	644	4	12	0	15	0	0	0	1	1
17087	0	1	0.121		-	0	0	1	0	0	0	0	0	0
	1	25	0.176	188	1,069	25	0	0	25	0	0	0	0	0
	2	27	0.177	213	1,201	27	0	0	27	0	0	0	0	0
	3	28	0.184	223	1,210	28	0	0	27	0	1	0	0	1
	4	28	0.187	216	1,154	28	0	0	28	0	0	0	0	0
	5	30	0.194	254	1,311	30	0	0	30	0	0	0	0	0
	6	32	0.206	255	1,240	32	0	0	32	0	0	0	0	0
	7	31	0.206	235	1,143	31	0	0	31	0	0	0	0	0
	8	2	0.221	11	50	1	1	0	1	1	0	0	0	1
	9	16	0.107	143	1,339	16	0	0	16	0	0	0	0	0
	10	14	0.138	118	856	14	0	0	13	0	0	0	0	0
	11	15	0.320	166	519	15	0	0	15	0	0	0	0	0
	12	11	0.335	102	305	10	0	1	9	0	1	0	0	1
	13	31	1.066	337	316	29	0	2	28	0	1	0	0	1
	14	17	0.353	137	388	17	0	0	17	0	0	0	0	0
	15	19	0.403	188	466	19	0	0	19	0	0	0	0	0
	16	39	0.994	361	363	36	1	2	36	0	1	0	1	2
17088	1	34	0.484	278	575	10	22	2	31	0	0	0	1	1
	2	40	0.251	367	1,460	33	7	0	40	0	0	0	0	0
	3	37	0.250	257	1,027	20	17	0	36	0	0	1	0	1
	4	25	0.348	359	1,031	15	9	1	23	0	0	0	1	1
	5	27	0.282	251	890	15	12	0	26	0	1	0	0	1
	6	29	0.179	213	1,188	21	8	0	29	0	0	0	0	0
	7	15	0.174	87	499	14	1	0	14	1	0	0	0	1
	8	13	0.523	80	153	9	0	4	8	3	1	0	0	4
	9	13	0.180	112	622	13	0	0	12	0	0	0	1	1
	10	30	0.298	258	866	28	2	0	30	0	0	0	0	0
	11	28	0.300	238	793	25	3	0	25	0	0	1	0	1
	12	19	0.187	175	937	17	2	0	18	0	1	0	0	1
	13	17	0.173	148	856	16	1	0	16	0	1	0	0	1

Table 6.1.1 Social Conditions Of The Pilot Study Area (3)

Zone Number	Block Number	No of Buildings	Parcels Area (ha)	Population	Density (person / ha)	Building Structure			Building Usage					
						Steel	Steel and Brick	Others	Residential	School	Workshop	Medical	Public Usage	Others
17089	1	31	0.310	303	978	20	11	0	30	0	1	0	0	1
	2	32	0.322	272	844	4	28	0	32	0	0	0	0	0
	3	32	0.331	306	923	1	31	0	32	0	0	0	0	0
	4	32	0.373	278	746	1	30	1	31	0	0	0	0	0
	5	52	0.599	535	893	0	52	0	52	0	0	0	0	0
	6	47	0.471	421	894	0	47	0	46	0	1	0	0	1
	7	40	0.395	395	1,001	1	39	0	39	0	1	0	0	1
	8	32	0.319	327	1,025	0	32	0	32	0	0	0	0	0
	9	24	0.238	247	1,038	0	24	0	24	0	0	0	0	0
17090	1	20	0.181	182	1,007	8	12	0	20	0	0	0	0	0
	2	23	0.153	178	1,163	3	20	0	23	0	0	0	0	0
	3	27	0.181	226	1,247	4	23	0	27	0	0	0	0	0
	4	31	0.209	255	1,218	4	27	0	31	0	0	0	0	0
	5	30	0.193	213	1,106	3	27	0	30	0	0	0	0	0
	6	11	0.092	72	787	1	10	0	11	0	0	0	0	0
	7	14	0.330	123	373	1	13	0	14	0	0	0	0	0
	8	14	0.331	103	312	1	12	1	13	0	0	0	1	1
	9	14	0.353	137	388	4	10	0	12	0	2	0	0	2
	10	16	0.370	145	392	3	13	0	16	0	0	0	0	0
	11	16	0.382	182	476	4	11	1	16	0	0	0	0	0
	12	28	0.219	249	1,136	2	26	0	27	0	0	0	1	1
	13	80	0.685	570	832	20	57	3	78	0	0	1	1	2
	14	17	0.390	147	377	5	12	0	16	0	1	0	0	1
	15	16	0.384	179	466	3	12	1	15	0	0	0	1	1
	16	1	0.212	7	33	0	1	0	0	1	0	0	0	1
17091	1	28	0.299	284	949	28	0	0	28	0	0	0	0	0
	2	26	0.284	235	828	26	0	0	26	0	0	0	0	0
	3	24	0.263	162	615	23	1	0	23	0	1	0	0	1
	4	24	0.245	231	942	23	1	0	24	0	0	0	0	0
	5	40	0.407	352	866	40	0	0	40	0	0	0	0	0

Table 6.1.1 Social Conditions Of The Pilot Study Area (4)

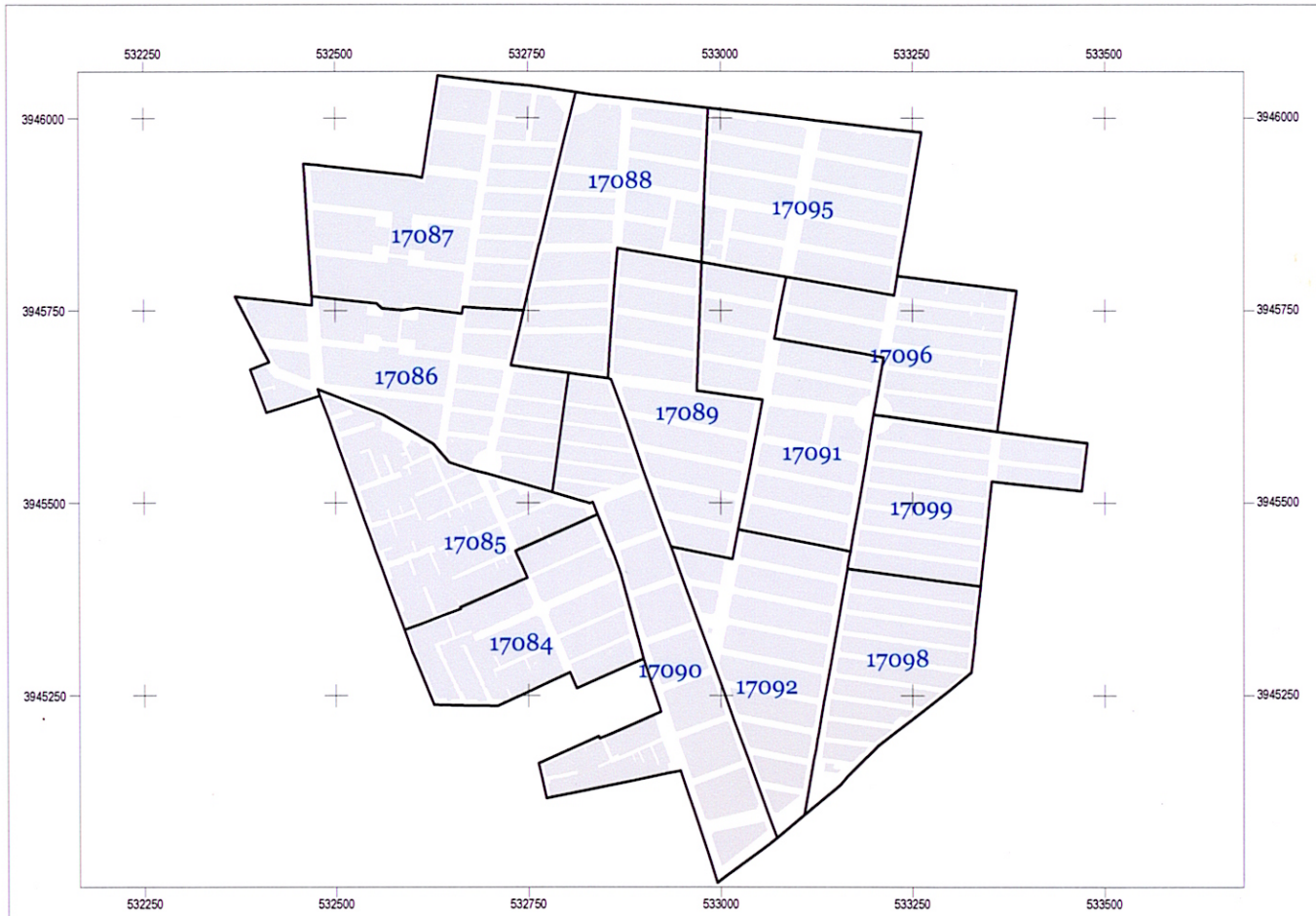
Zone Number	Block Number	No of Buildings	Parcels Area (ha)	Population	Density (person / ha)	Building Structure			Building Usage					
						Steel	Steel and Brick	Others	Residential	School	Workshop	Medical	Public Usage	Others
17091	6	27	0.336	219	652	26	0	1	25	1	0	0	1	2
	7	2	0.316	-	-	2	0	0	0	2	0	0	0	2
	8	11	0.195	80	410	10	0	1	8	0	0	1	1	2
	9	41	0.414	403	973	41	0	0	41	0	0	0	0	0
	10	43	0.417	381	914	35	8	0	43	0	0	0	0	0
	11	42	0.423	364	860	39	3	0	40	0	1	0	1	2
17092	1	44	0.425	409	962	31	11	2	42	0	2	0	0	2
	2	43	0.417	399	958	16	27	0	43	0	0	0	0	0
	3	16	0.167	155	927	7	9	0	16	0	0	0	0	0
	4	7	0.090	71	787	3	2	2	6	0	1	0	0	1
	5	44	0.439	419	954	10	33	1	43	0	1	0	0	1
	6	42	0.434	320	737	3	39	0	39	0	1	0	1	2
	7	1	0.004		-	0	0	1	0	0	0	0	0	0
	8	41	0.426	362	850	8	33	0	41	0	0	0	0	0
	9	34	0.355	263	742	6	28	0	34	0	0	0	0	0
	10	27	0.277	257	929	2	25	0	27	0	0	0	0	0
	11	20	0.208	206	992	5	15	0	20	0	0	0	0	0
	12	1	0.078	6	77	0	1	0	0	1	0	0	0	1
17095	1	40	0.421	375	891	12	28	0	40	0	0	0	0	0
	2	40	0.410	382	932	3	37	0	40	0	0	0	0	0
	3	39	0.410	340	829	2	37	0	38	0	1	0	0	1
	4	41	0.432	336	778	1	40	0	39	1	2	0	0	3
	5	30	0.385	221	574	7	23	0	25	0	3	2	0	5
	6	30	0.326	192	589	11	18	1	25	1	0	3	1	5
	7	36	0.377	359	951	5	31	0	36	0	0	0	0	0
	8	34	0.357	322	903	8	26	0	33	0	1	0	0	1
	9	21	0.231	199	860	5	16	0	21	0	0	0	0	0
	10	22	0.234	189	806	7	15	0	22	0	0	0	0	0
	11	1	0.040		-	1	0	0	0	0	0	0	1	1
17096	1	40	0.415	354	852	37	3	0	40	0	0	0	0	0
	2	40	0.413	347	840	30	9	1	40	0	0	0	0	0

Table 6.1.1 Social Conditions Of The Pilot Study Area (5)

Zone Number	Block Number	No of Buildings	Parcels Area (ha)	Population	Density (person / ha)	Building Structure			Building Usage					
						Steel	Steel and Brick	Others	Residential	School	Workshop	Medical	Public Usage	Others
17096	3	45	0.326	353	1,084	29	16	0	45	0	0	0	0	0
	4	40	0.336	283	841	38	1	1	38	0	0	0	2	2
	5	43	0.349	373	1,070	37	6	0	43	0	0	0	0	0
	6	47	0.347	350	1,010	28	19	0	47	0	0	0	0	0
	7	42	0.363	318	875	3	39	0	41	1	0	0	0	1
	8	44	0.334	391	1,170	1	42	1	43	0	0	1	0	1
17098	1	3	0.017	26	1,504	0	3	0	3	0	0	0	0	0
	2	14	0.099	116	1,175	3	11	0	14	0	0	0	0	0
	3	23	0.164	166	1,014	3	20	0	22	0	1	0	0	1
	4	31	0.216	248	1,148	1	30	0	31	0	0	0	0	0
	5	38	0.288	299	1,038	2	36	0	37	0	1	0	0	1
	6	50	0.344	371	1,078	0	50	0	50	0	0	0	0	0
	7	50	0.372	383	1,029	1	48	1	48	0	2	0	0	2
	8	49	0.370	402	1,087	3	46	0	49	0	0	0	0	0
	9	53	0.368	399	1,086	1	52	0	52	0	1	0	0	1
	10	48	0.362	345	954	3	45	0	45	0	3	0	0	3
17099	1	48	0.356	349	979	3	45	0	47	0	1	0	0	1
	2	40	0.355	272	766	2	37	1	39	0	0	0	1	1
	3	49	0.343	360	1,050	2	47	0	49	0	0	0	0	0
	4	46	0.332	306	921	4	42	0	44	0	2	0	0	2
	5	45	0.343	313	914	6	39	0	44	0	0	0	0	0
	6	44	0.338	330	977	6	38	0	42	0	1	1	0	2
	7	40	0.358	330	921	3	37	0	38	0	0	0	2	2
	8	31	0.307	260	846	5	26	0	30	0	0	0	0	0
	9	33	0.223	254	1,140	0	33	0	33	0	0	0	0	0
Total	149	4,464	47	38,130	803	1,573	2,838	53	4,332	13	47	17	24	101

Figure 6.1.1

Location Map (Pilot Study Area)



Legend

17089 Census Zones (Code No.)
Census Blocks

N
W E
S

100 0 100 200 Meters

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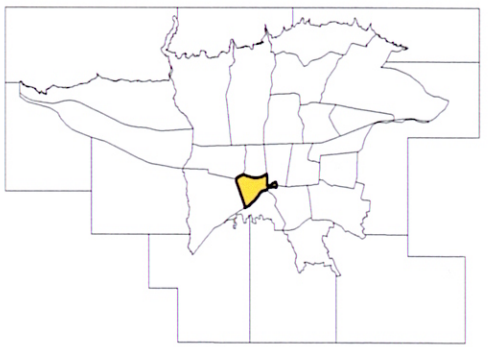
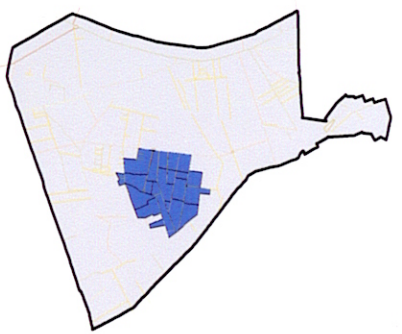


Location of District 17 in Greater Tehran



Location of Pilot Study Area in District 17

6.1.3. Detailed Building Survey

A detailed building survey was conducted to collect basic data on existing conditions of urban land use and seismic disaster preparedness of the PSA. The survey data were used to build a GIS database. Necessary processing and an analysis were conducted afterwards. Based on this data analysis, the Study Team was able to produce a regional diagnosis for the seismic disaster preparedness of the PSA. Table 6.1.2 shows surveyed items for each building in the PSA.

Table 6.1.2 Detailed Building Survey Items

Street Code	Alley Code	Building No.	Building Code	No. of Floors	No. of Dwelling Units	Type of Building Use	No. of Households	No. of Residents	Construction Year	Accessible Lifelines					Building Structure									
																	Others							
										Service Water	Sewage	Electricity	Gas	Telephone	RC	Steel	Brick and Steel, or Stone and Steel	Brick and Wood, or Stone and Wood	Cement Block [with any kind of roof]	All Brick, or Stone and Brick	All Wood	Sun-dried Mud Brick and Wood	Sun-dried Mud Brick and Mud	Others

6.1.4. Diagnosis for Seismic Disaster Preparedness of the PSA

Issues and problems for seismic disaster preparedness in the PSA are described below based on the diagnosis of the PSA from the viewpoint of mitigating a seismic disaster.

(1) Largest Estimated Seismic Ground Motion

As a basic condition of seismic disaster mitigation, the Study Team estimated the largest ground motion that could occur in the PSA. It was calculated at more than 400 gal with an intensity of 9 in MMI scale. This category covers the entire PSA area.

(2) Liquefaction Potential

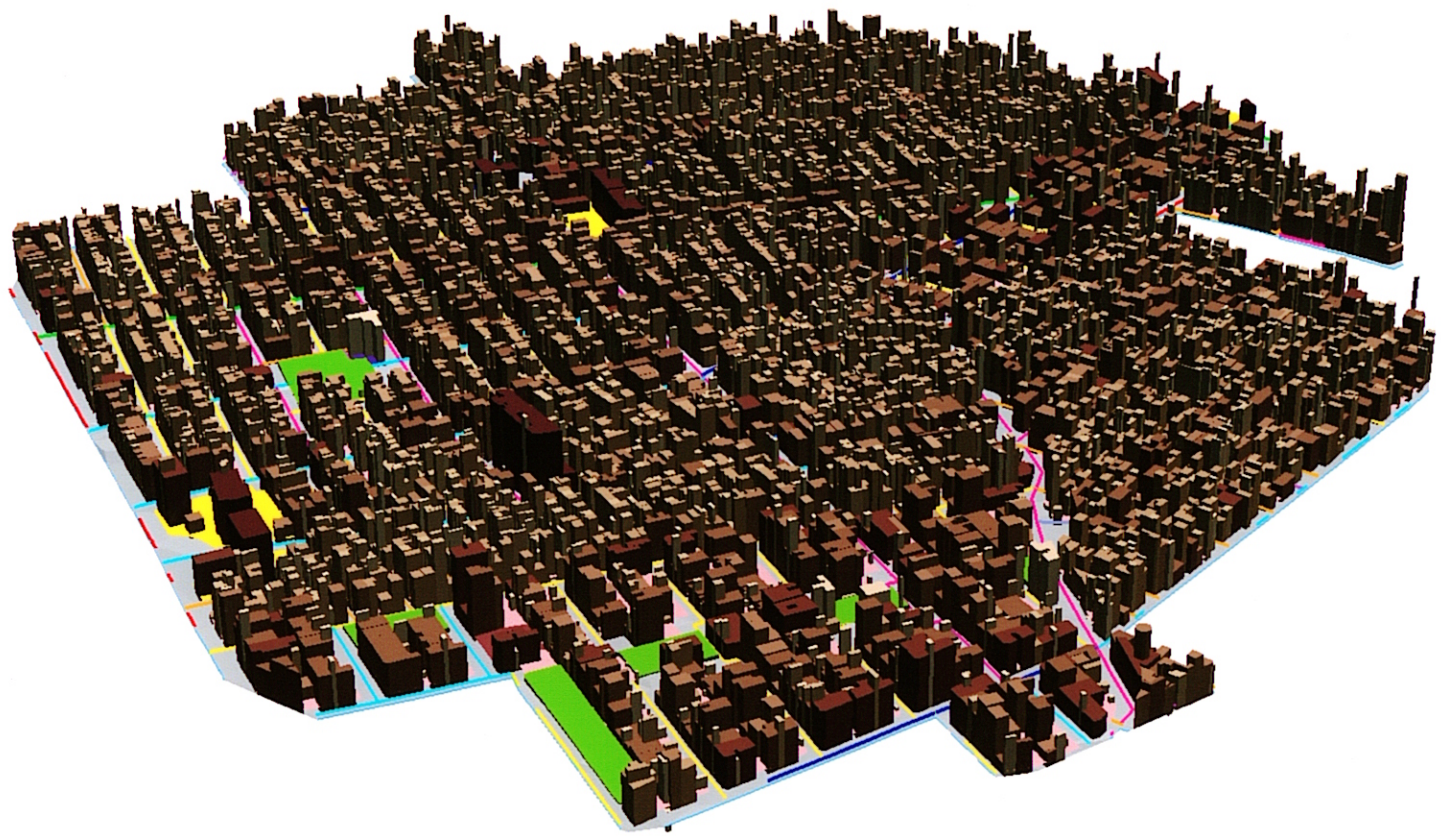
The ground condition of the PSA is mainly composed of alluvial clayey soil. This clayey deposit is well consolidated and ground water level in the area is 20 meters below the ground surface. Due to these ground conditions, liquefaction potential of the PSA is very low.

(3) Building Damage

Almost all of the buildings in the PSA will be either heavily damaged or will totally collapse due to the Ray Fault Earthquake. The damage ratio for the buildings is estimated at more than 80%, according to the available damage function data. Only zone 87 showed 60% to 70 % of building damage ratio because 97% of buildings in this zone are of steel structures. From the PSA' s GIS database, the Study Team developed a detailed 3-D model. Using this model, bird' s-eye views are prepared to present a specific image before and after the occurrence of a seismic disaster in the PSA (Figure 6.1.2 and Figure 6.1.3).

Figure 6.1.2

3D View - Existing



Note : Not to Scale

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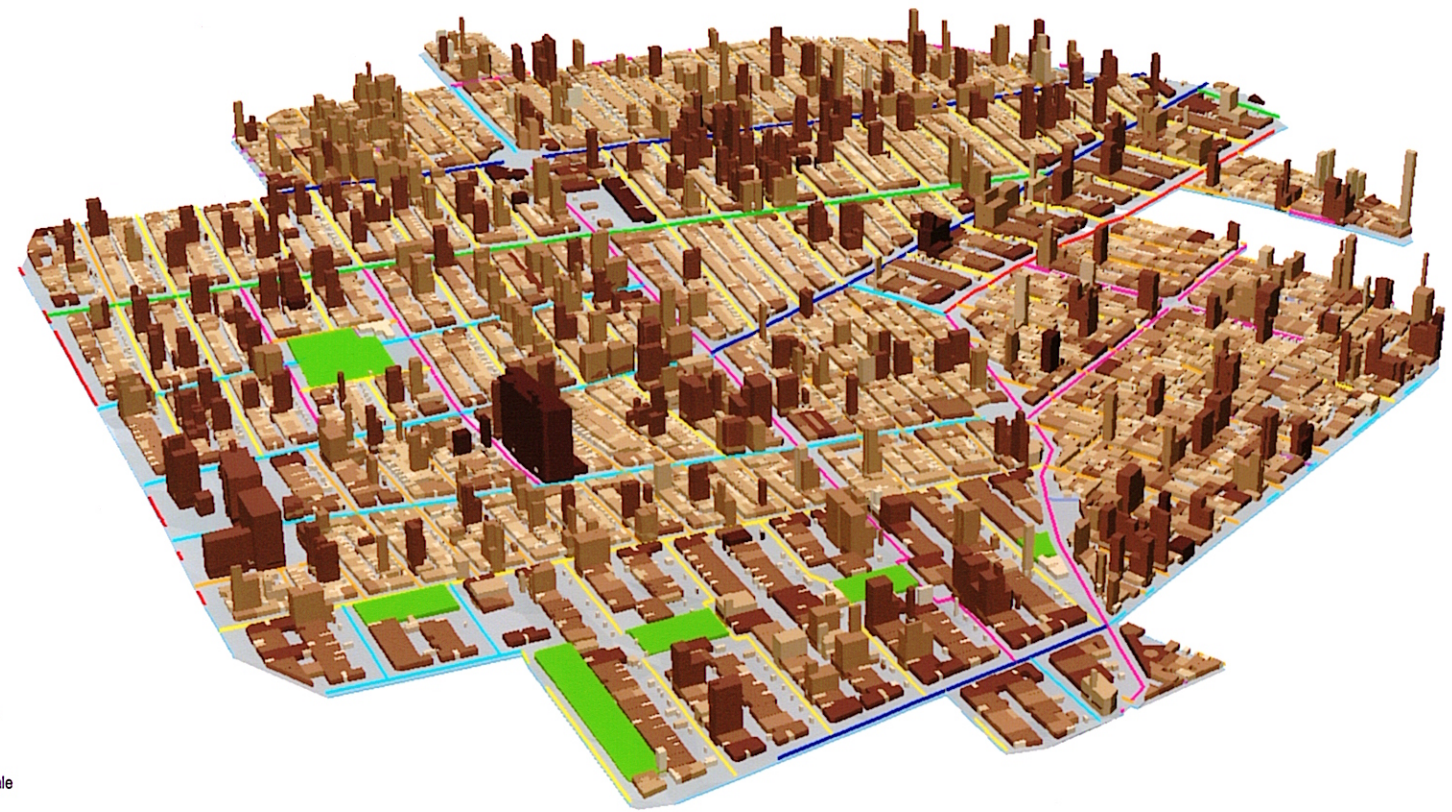
Figure 6.1.3

3D View - After Damage



Note : Not to Scale

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